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Research Article

# Effect of different tillage practices and nitrogen level on wheat production under inner terai of Nepal

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## ABSTRACT

A field experiment was conducted to evaluate the plant height, yield and yield attributes of wheat under different tillage practices and nitrogen level at Dang, Nepal during winter season 2018-19. The experiment was laid out in split plot design with two tillage practices viz. zero tillage and conventional tillage as main plot factor and four level of N viz. 50 kg ha$^{-1}$, 75 kg ha$^{-1}$, 100 kg ha$^{-1}$and 125 kg ha$^{-1}$ as sub plot factor and each replicated thrice. The result revealed that there is no significant relation between tillage practice and plant height of wheat while N level significantly affect the plant height. 125 kg N ha$^{-1}$ recorded the highest plant height (110.7 cm). Zero tillage recorded the highest effective tiller m$^{-2}$ (254) and grain yield (3.3 t ha$^{-1}$) whereas spike length, grain spike$^{-1}$, biological yield and harvest index were not significant with tillage practices. Regarding the N level, 125 kg N ha$^{-1}$ recorded the highest effective spike m$^{-2}$ (279), spike length (10.6 cm), grain spike$^{-1}$ (48), thousand grain weight (46.3 g), grain yield (3.6 t ha$^{-1}$) and biological yield (9.4 t ha$^{-1}$). 50 kg N ha$^{-1}$ recorded the highest harvest index (42.9%). The interaction between the tillage practice and nitrogen level showed the significant effect on grain yield and harvest index where as other parameters showed non-significant relation. The zero tillage with 125 kg N ha$^{-1}$ recorded the highest grain yield (3.9 t ha$^{-1}$).

**Key words:** wheat, tillage practices and nitrogen level

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**INTRODUCTION**

Wheat (*Triticum aestivum* L.) is the most important cereal crop in Nepal, it ranks third in position after rice and maize in terms of area and production. It is grown in 0.7 million ha of land with its production 1.9 million t and productivity 2.75 t $ha^{-1}$ (MOAD, 2018). It can be grown in wide range of topographic, edaphic and climatic conditions. It is grown from below sea level to 5000 m altitude and in areas where rainfall ranges between 300-1130 mm (Maskey et al, 2000). Wheat contributes more calories (20%) and more protein (21%) to the world's diet than any other food crop . It is nutritious, easy to store and transport and can be processed into various types of food (Kandel et al., 2018). It is a major winter cereal crop in Nepal and more than 80% of wheat is grown in rice-wheat cropping pattern (Kandel et al., 2018; Shrestha et al., 2018). The agriculture sector of Nepal, which shares 27.6% to the Gross Domestic Product (GDP) is greatly influenced by the change in national wheat production (Subedi et al., 2019). After the introduction of semi-dwarf varieties from Mexico, the area and production of wheat in Nepal has been increased dramatically and now it has significant contribution to the national food supply (Paudel et al., 2012; Pandey et al., 2019).

The production of wheat depends on the proper inputs, better agronomic practices and tillage methods. Tillage refers to the physical manipulation of soil. The conventional tillage (CT) refers to the intensive tillage with multiple passes of tillage equipment to accomplish land preparation for seed sowing. Conventional tillage practices cause change in soil structure by modifying soil bulk density and soil moisture content. Conventional tillage is often helpful to break plough pan, improve infiltration, adding of organic and chemical amendments in light textured soils. As a consequence, organic matter decomposition is enhanced and mineral nutrients are readily available to crop (Higashida, 2003). It also involves intensive soil manipulation, wastage of energy resources, lacks sustainability and results environmental hazards (Wang, 2012). Conservation tillage deal with the minimum soil manipulation while leaving stubbles from previous crop on soil surface. Sometimes stubbles are also buried into soil, useful to enhance organic matter. Conservation tillage favors timely sowing of crops, minimizes cost, improves soil aggregate stability and protects environment on long term basis. It is economically feasible, environmentally sound, socially acceptable and sustainable (Fuentes, 2011). Zero tillage is type of conservation tillage is an extreme farm of reduce tillage where wheat is planted in prepared soil after rice is harvested in a narrow slit wide enough to cover the seed without any tillage. It affects water availability to plants, essentially through soil water capture and root uptake capacity (Gajri, 1994). Moreover, zero tillage reduces the number of field operations reducing input costs for labour, fuel, tractors, and other equipment. It generally results in greater economic returns, compared with conventional tillage system, due to both greater yields in dry years and smaller production costs in all years (Smart, 1999).
Nutrient management is of paramount importance in deciding production and productivity of any crop. The depletion of nutrient reserves in the soil is a major but often hidden form of land degradation. Application of inadequate and imbalanced fertilization to crops not only results in low crop yields but also deteriorates the soil health (Sharma et al., 2003). Nitrogen is the most limiting nutrient in crop production and its efficient use to increase food production is more than any other input; however, much use of N may cause environmental concerns such as nitrate leaching, eutrophication, and greenhouse gases emissions and reduce crop yield (Malhi

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et al., 2001). Therefore, proper use of N is critical to optimize crop yield and minimize environmental damage.

## MATERIALS AND METHODS

This research was conducted at agronomy farm of Prithu Technical College Lamahi Municipality, Dang district in the Province No. 5, inner Terai region of Nepal during the winter season, 2018 to study the effect of different tillage practices and level of N. Geographically, it is located at 27°99' N latitude and 82°30' E longitude. The experimental site has silty loam soil with pH 6.7, soil organic matter 2.1%, available N, $P_2O_5$ and $K_2O$ were 0.1%, 45 kg ha$^{-1}$, and 190.8 kg ha$^{-1}$ respectively.

The experiment was laid out in to split plot design with two tillage practices viz. zero tillage and conventional tillage as main plot factor and four level of N viz. 50 kg ha$^{-1}$, 75 kg ha$^{-1}$, 100 kg ha$^{-1}$ and 125 kg ha-$^{1}$ as sub plot factor and each replicated thrice. The unit plot size was 9 m$^{-2}$ (3 m x 3m) and the unit plot and replication were separated by 0.5 m. The zero-tillage system was followed in the plots after rice harvest in the presence of rice stubbles with just scrap in the soil while, in conventional tillage three ploughing was followed by planking. N was applied form urea (46% N) and applied in three split dose. Half dose of N applied as basal dose and remaining N applied during crown root initiation (CRI) stage and booting stage. P and K both were applied @ of 50 kg ha$^{-1}$ through DAP (18% N and 46% $P_2O_5$) and MOP (60% $K_2O$) respectively. Full dose of P and K applied as basal dose. Pre-sowing irrigation was done due to less moisture level in soil. After sowing irrigation during CRI stage, booting stage and grain filling stage were done. 2,4 D was used at 30 DAS @ 1 ml/ lit of water to control the weed and frequent hand weeding was done depending upon the infestation of weed. Vijay, a popular wheat variety released in 2011 for plain areas of Nepal, was used for line sowing in both tillage practices maintaining 20 cm between R-R.

Plant height was recorded during physiological maturity. For plant height ten hills were selected from 3rd and 6th row of each plot and measured from soil surface to the tip of spike. The mean height of ten plants is expressed as plant height of each plot. Similarly, yield and yield attributing characters like effective tillerm$^{-2}$, spike length, number of grain spike$^{-1}$, thousand grain weight (g), grain yield and straw yield were recorded from the unit plot. The grain and straw were sun dried and converted to t ha-1 with 12% moisture content of grain. The biological yield and harvest index were calculated by using following formula:
Biological yield = Grain yield + Straw yield
Harvest index = (Grain yield / Biological yield) x 100

Collected data were analyzed statistically using R-program with agricolae package. Least significant difference (LSD), as mean separation technique was applied to identify the most efficient treatment (Gomez & Gomez 1984; Shrestha, 2019).

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## RESULTS AND DISCUSSION

### Effect of tillage practice on wheat

The height of wheat was not affected by the different tillage practices of tested wheat variety. Regarding yield and yield attributing characters, tillage practices significantly affected the effective tiller m-$^{2}$ and grain yield. Zero tillage recorded the maximum number of effective spike m$^{-2}$ (253.7) and grain yield (3.3 t ha$^{-1}$) whereas conventional tillage recorded the lowest number of effective spike m$^{-2}$ (235.8) and grain yield (2.7 t ha$^{-1}$). This result is also in line with the finding of Khan et al. (2017), and Ali et al. (2013) who also find the maximum number of effective spike m$^{-2}$ and grain yield in zero tillage over the deep tillage and minimum tillage The highest grain yield recorded in zero tillage due to maximum number of effective spike m$^{-2}$. Spike length, grain spike$^{-1}$, thousand grain weight, biological yield and harvest index were statistically at par between two tillage practices.

### Effect of N levels on wheat

Different level of nitrogen statistically affected the plant height of tested wheat variety. Plant height was increased with increase in nitrogen level. 125 kg N ha$^{-1}$ recorded the maximum plant height (110.7 cm) which is statistically similar with the 100 kg N ha-$^{1}$ whereas 50 kg N ha$^{-1}$ recorded the lowest plant height (98.5 cm). This result is also in line with the findings of Ullah et al. (2018), Liaqat et al (2003) who also reported that plant height was increasing with increasing level of nitrogen up to 200 kg ha$^{-1}$. Similarly, different level of nitrogen also influenced the yield and yield attributing characters of wheat. Maximum number of effective spike m$^{-2}$ (279), spike length (10.6 cm), grain spike$^{-1}$ (48), thousand grain weight (46.3 g) and grain yield (3.6 t ha$^{-1}$) were recorded at 125 kg N ha$^{-1}$ followed by 100 kg N ha$^{-1}$ whereas 50 kg N ha$^{-1}$ recorded the lowest values for all of these traits. This result is in conformity with the finding of Ali et al. (2011), who also recorded the maximum grain yield and yield attributing characters with 120 kg N ha$^{-1}$ over other level of nitrogen. Similarly, 125 kg N ha$^{-1}$ recorded the highest biological yield (9.4 t ha$^{-1}$) which was statistically similar with the 100 kg N ha$^{-1}$ whereas 50 kg N ha$^{-1}$ recorded the lowest biological yield. But regarding the harvest index 50 kg N ha$^{-1}$ recorded the highest harvest index followed by the 125 kg N ha$^{-1}$ which was statistically similar with the 100 kg N ha$^{-1}$ and 75 kg N ha$^{-1}$.

### Interaction effect of different tillage practices and nitrogen levels on wheat

The interaction of different tillage practices and level of N had statistically effect on grain yield and harvest index; however it was not significant for plant height, effective spike m$^{-2}$, spike length, grain per spike, thousand grain weight and biological yield (Table 2). The treatment combination: zero tillage with 125 kg N ha$^{-1}$ recorded the maximum grain yield (3.9 t ha$^{-1}$) which was statistically similar with the treatment combination: zero tillage and 100 kg N ha$^{-1}$. Whereas, the treatment combination zero tillage with 50 kg N ha$^{-1}$ recorded the lowest grain yield. Similarly, the treatment combination conservation tillage (CT) with 50 kg N ha$^{-1}$ recorded the highest harvest index, which is statistically similar with the treatment combination zero tillage (ZT) with 75 kg N ha$^{-1}$. The treatment combination CT with 75 kg N ha$^{-1}$ recorded the lowest harvest index.

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## CONCLUSION

The different tillage practices and nitrogen level in wheat production significantly affected the plant height, yield and yield components of wheat. The zero tillage and 125 kg N $ha^{-1}$ produced the highest grain yield and effective spike $m^{-2}$. Similarly, the combination of zero tillage with 125 kg N $ha^{-1}$ produced the maximum grain yield which is at par with the combination of zero tillage with 100 kg N $ha^{-1}$ . Thus, the combination of zero tillage with 125 kg N $ha^{-1}$ or 100 kg N $ha^{-1}$ will best for wheat cultivators however, it requires more investigation.

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### Author contributions

S. Bartaula conducted the trial and recorded data, analyzed and wrote the final manuscript. U. Panthi, A. Adhikari, M. Mahato, D. Joshi and K. Aryal helped in data recording.

### Conflict of interest

The authors declare no conflicts of interest regarding publication of this manuscript.

## REFERENCES

Ali, I., Shafi, J., Akbar, N., Ahmad, W., Ali, M., & Tariq, S. (2013). Different tillage practices grown under rice- wheat cropping system. *Universal Journal of Plant Science, 1*(4), 125-131.

Fuentes, A., Yadav, A., & Kumar, A. (2011). Effect of tillage and nutrient management on wheat productivity and quality in Haryana, India. *Field Crop Research*, *133*, 134-140.

Gajri, P.R., Arora, V.K., & Chaudhary, M.R. (1994). Maize growth response to deep tillage, straw mulching and farmyard manure in coarse textured soils of NW India Soil Use Manage. *An International Journal for the British Society of Soil Science*, *101*, 5-20.

Geleto, T., Tanner, D.G., Mamo, T., & Gebeyehu, G. (1995). Response of rain fed bread and durum wheat to source level and timing of nitrogen fertilizer on two Ethiopian vertisole S. I. yield and yield components. *Communications in Soil Science and Plant Analysis*, *26*, 1773–1794.

Gomez, K.A., & Gomez, A.A. (1984). Statistical Procedure of Agricultural Research. 2nd edition. John Wiley and Sons Inc. New York.

Higashida, S., & Amagami, M.Y. (2003). Effects of deep ploughing with concomitant application of farm manure on the productivity of arable crops, *Bulletin of Hokkaido-Prefectural Agricultural Experiment Stations*, *84*, 55-64.

Kandel, M., Bastola, A., Sapkota, P., Chaudhary, O., Dhakal, P., & Shrestha, J. (2018). Analysis of genetic diversity among the different wheat (*Triticum aestivum* L.) genotypes. *Turkish Journal of Agricultural and Natural Sciences, 5*(2), 180-185.

Khan, H.Z., Shabir, M.A., Akbar, N., Iqbal, A., Shahid, M., Shakoor, A., & Sohail, M. (2017). Effect of different tillage techniques on productivity of wheat (*Triticum aestivum* L.), *Journal of Agriculture and Basic Sciences*, *2*, 1.

ISSN: 2661-6270 (Print), ISSN: 2661-6289 (Online)
DOI: https://doi.org/10.3126/janr.v3i1.27177

Liaqat, A., Din, Q.M.U., & Ali, M. (2003). Effect of different doses of nitrogen fertilizer on the yield of wheat. *International Journal of Agriculture & Bioresearch, 5*(4), 438-439.

Malhi, Y., Christopher, D., & David, G. (2011). The allocation of ecosystem net primary productivity in tropical forests. The Royal Society Publishing, *366*(1582), 3225–3245

Maskey, S.L., Shrestha, R.K., Shrestha, B., Tripathi, B.P., Munanakamy, R.C., Khadka, Y.G., Bhattarai, E.M., & Shrestha, S.P. (2000). Strategy for soil fertility research in the hills of Nepal, Soil Science Division, NARC, Khumaltar, Lalitpur, Nepal, 162 p.p.

Mishra, J.S., Singh, V.P., & Yaduraju, N.T. (2005). Effect of tillage practices and herbicides on weed dynamics and yield of wheat under transplanted rice-wheat system in vertisol, *Indian Journal of Agronomy, 50* (2), 106- 109.

MOAD (2018). Statistical information on Nepalese agriculture. Government of Nepal Ministry of Agricultural Development Agri Business Promotion and Statistics Division. Agri-statistics Section Singha Durbar, Kathmandu Nepal.

Nikam, B.T. (1985). Studies on the effects of fertilizer on growth, yield and quality of wheat (HD 2189) in Rabi season, M.Sc. Thesis, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar (M.S.)

Pandey, D.,Chaudhari, H.K., Upadhyay,S.R., Gautam, N.R., Ghimire, B.R., Shrestha, J., & Thapa, D.B. (2019). Participatory on-farm evaluation of wheat varieties. *Journal of Agriculture and Natural Resources*, *2*(1), 312-321

Paudel, D. C., Shrestha, J., Hamal, G. B., Aryal, A., Adhikary, B. H., Rijal, T. R., & Tripathi, M. P. (2012). On-farm evaluation of wheat genotypes at outreach sites of NMRP Rampur, Chitwan, Nepal. In: Paudel MN and Kafle B (eds.), Proceeding of the 10th National Outreach Research Workshop 27-28 February, 2012, Outreach Research Division, NARC, Khumaltar. Pp.54-61

Sharma, M.P., Bal, P., & Gupta J.P. (2003). Long term effects of chemical fertilizers on rice-wheat productivity. *Annals of Agricultural Research*, *24*(1), 91-94.

Shrestha, J. (2019). P-Value: A true test of significance in agricultural research. Retrieved from *https://www.linkedin.com/pulse/p-value-test-significance-agricultural-research-jiban-shrestha/*

Smart, J.R., & Bradford, J.M. (1999). Conservation tillage corn production for a semi-arid, subtropical environment. *Agronomy Journal*, *91*, 116-121

Subedi, S., Ghimire, Y.N., Adhikari, S.P., Devkota, D., Shrestha, J., Poudel, H.K., & Sapkota, B.K. (2019). Adoption of certain improved varieties of wheat (Triticum aestivum L.) in seven different provinces of Nepal. *Archives of Agriculture and Environmental Science*, *4*(4) 404-409

Tayebeh, A., Abbas, A., & Seyed, A.K. (2011). Wheat Yield and Grain Protein Response to Nitrogen Amount and Timing. *Australian Journal of Crop Science*, *5*(3), 330-336.

Verch, S.K., Gong, Y., & Fan, M., (2009). Effects of 11 years of conservation tillage on soil organic matter fractions in wheat. *Soil and Tillage Research*, *106*, 85-94.

Wang, X., Wu, H., & Dai, K. (2012). Tillage and crop residue effects on rainfed wheat and maize production in northern China. *Field Crop Research*, *132*, 106-116.

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**Table 1: Effect of tillage practices and nitrogen level on growth, yield and yield attributes of wheat**

| Treatment | Plant height (cm) | Effective tillerm$^{-2}$ | Spike Length (cm) | Grain spike$^{-1}$ | 1000 grain Weight (g) | Grain yield (t ha$^{-1}$) | Biological yield (t ha$^{-1}$) | HI (%) |
|---|---|---|---|---|---|---|---|---|
| Tillage practice | | | | | | | | |
| ZT | 106.9 | 254$^a$ | 10.0 | 43.0 | 44.2 | 3.3$^a$ | 8.1 | 41.6 |
| CT | 103.6 | 236$^b$ | 10.0 | 43.0 | 43.4 | 2.7$^b$ | 7.7 | 36.5 |
| LSD (0.05) | NS | 9.0* | NS | NS | NS | 0.1* | NS | NS |
| Level of Nitrogen (kg ha-1) | | | | | | | | |
| 50 | 98.5c | 201$^d$ | 9.2$^c$ | 38.0$^c$ | 41.4$^c$ | 2.4$^d$ | 5.7$^c$ | 42.9$^a$ |
| 75 | 103.2$^b$ | 241$^c$ | 9.8$^{bc}$ | 42.0$^b$ | 43.6$^b$ | 2.9$^c$ | 7.7$^b$ | 37.6$^b$ |
| 100 | 108.7$^a$ | 257$^b$ | 10.3$^{ab}$ | 44.0$^b$ | 44.0$^b$ | 3.3$^b$ | 8.9$^a$ | 37.5$^b$ |
| 125 | 110.7$^a$ | 279$^a$ | 10.6$^a$ | 48.0$^a$ | 46.3$^a$ | 3.6$^a$ | 9.4$^a$ | 38.0$^b$ |
| LSD (0.05) | 6.2** | 13.0** | 0.9** | 5.3** | 2.1** | 0.2** | 1.1** | 4.3* |
| CV (%) | 3.3 | 4.2 | 4.8 | 6.9 | 3.8 | 5 | 10.9 | 8.8 |
| Grand Mean | 105.3 | 244.7 | 10 | 43.1 | 43.8 | 3.1 | 7.9 | 39 |

*Treatments means followed by the same letter (s) within column are non-significantly different among each other at 5% level of significance. '*' and '**' indicate statistically different means at 5% and 1% significant level respectively. LSD= Least significant difference and CV= Coefficient of variation*

**Table 2: Interaction effect of different tillage practices and level of N on growth, yield and yield attributing characters of wheat**

| Tillage practice | Nitrogen level (kg ha$^{-1}$) | PH | ES | SL | GPS | TGW | GY | BY | HI |
|---|---|---|---|---|---|---|---|---|---|
| ZT | 50 | 98.5 | 201 | 9.1 | 37 | 42.5 | 2.3$^d$ | 6 | 41.5$^{ab}$ |
| ZT | 75 | 104.2 | 247 | 10 | 42 | 43.8 | 3.3$^b$ | 7.6 | 42.9$^a$ |
| ZT | 100 | 110.5 | 278 | 10.3 | 44 | 43.9 | 3.7$^a$ | 9 | 41.8$^{ab}$ |
| ZT | 125 | 114.3 | 289 | 10.5 | 50 | 46.8 | 3.9$^a$ | 9.8 | 40.1$^{ab}$ |
| CT | 50 | 98.4 | 201 | 9.3 | 38 | 40.4 | 2.4$^d$ | 5.5 | 44.4$^a$ |
| CT | 75 | 102.2 | 235 | 9.6 | 42 | 43.4 | 2.5$^d$ | 7.8 | 32.3$^c$ |
| CT | 100 | 107 | 236 | 10.3 | 45 | 44.2 | 2.9$^c$ | 8.7 | 33.2$^c$ |
| CT | 125 | 107 | 270 | 10.8 | 47 | 45.8 | 3.2$^b$ | 9 | 35.8$^{bc}$ |
| **LSD (0.05)** | | NS | NS | NS | NS | NS | 0.3** | NS | 6.1* |
| **CV (%)** | | 3.3 | 13.0 | 4.8 | 6.9 | 3.8 | 5 | 10.9 | 11.6 |
| **Grand Mean** | | 105.3 | 245.0 | 10 | 43.1 | 43.8 | 3.1 | 7.9 | 39 |

*Treatments means followed by the same letter (s) within column are non-significantly different among each other at 5% level of significance. '*' and '**' indicate statistically different means at 5% and 1% significant level respectively. LSD= Least significant difference and CV= Coefficient of variation PH= plant height, EH= effective spike m$^{-2}$, SL= Spike length, GPS= Grain spike$^{-1}$, TGW= Thousand grain weight, GY= Grain yield, BY= Biological yield, HI= Harvest index*